# EXECUTIVE SUMMARY

This report presents the results of a study conducted by five U.S. Department of Energy national laboratories that quantifies the potential for energy-efficient and low-carbon technologies to reduce carbon emissions in the United States.[1] The study documents in detail how four key sectors of the economy – buildings, transportation, industry, and electric utilities – could respond to directed programs and policies to expand adoption of energy-efficiency and low-carbon technologies, an increase in the relative price of carbon-based fuels by $25 or $50/tonne (e.g., as a result of a cap on domestic carbon emissions and a market for carbon "permits"), and an aggressive program of targeted research and development. Current projections suggest that a carbon emissions reduction of 390 million metric tons per year (MtC/year) is required to stabilize U.S. emissions in 2010 at 1990 levels.

The study, which has been peer-reviewed by industry and academic experts, uses a technology-by-technology assessment as well as an engineering-economic modeling approach. It draws upon a wide variety of technology cost and performance information to assess potential impacts. Analysis of the buildings, industry, and transportation sectors quantifies the impacts of end-use energy-efficiency improvements on carbon emissions. The utility sector analysis estimates the impacts of those improvements on utility carbon emissions, and quantifies additional emissions reductions through conversion of a number of coal power plants to natural gas, dispatching of the utility grid with $25 and $50/tonne carbon permit prices, the accelerated use of biomass cofiring and wind energy, and other low-carbon electricity supply options. Finally, a number of other promising low-carbon technologies are examined to determine their potential for reducing emissions in the end-use sectors, including advanced gas turbines in industry, transportation biofuels, and fuel cells in buildings.

Three overarching conclusions emerge from the analysis of alternative carbon scenarios. First, a vigorous national commitment to develop and deploy energy-efficient and low-carbon technologies has the potential to restrain the growth in U.S. energy consumption and carbon emissions such that levels in 2010 are close to those in 1997 (for energy) and 1990 (for carbon). We analyze a case in which energy efficiency can reduce carbon emissions by 120 MtC/year by 2010. We analyze a second case, with policies that promote adoption of energy-efficient and low carbon technologies and a $25/tonne carbon permit price, with emission reductions of 230 MtC/year in 2010. Under a $50/tonne carbon permit price and aggresive policies, 2010 emissions could be cut by about 390 MtC/year. The analysis also suggests that substantial additional savings are available if permit prices were to begin to rise above the $50/tonne level.

The second conclusion is that, if feasible ways are found to implement the carbon reductions as described above, all the cases (with reductions varying between 120 and 390 MtC/year by 2010) can produce energy savings that are roughly equal to or exceed costs.[2] The analysis includes only technologies estimated to be cost-effective under 2010 energy prices (with a $25/tonne and $50/tonne carbon permit price for the respective cases); it has not, however, analyzed specific policies to achieve the cases, identified the political feasibility of policies, or described a pathway to achieve the cases.

The third conclusion is that a next generation of energy-efficient and low-carbon technologies promises to enable the continuation of an aggressive pace of carbon reductions over the next quarter century. This report documents a wide array of advanced technology options that could be cost-competitive by the year 2020, assuming a vigorous and sustained program of energy R&D beginning now and extending beyond 2010.

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[1] The five national laboratories participating in the study were: Argonne National Laboratory (ANL), Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL). LBNL and ORNL were the co-leaders of the effort.

[2] Here we count as benefits only the energy savings to the nation. We have not credited reduced $CO_2$ emissions or other external benefits. Costs include the increased technology cost plus an approximate estimate of the costs of program and policy implementation.